Lightweight and Flexible Metal Halide Perovskite Thin Films for High Temperature Solar Cells

Completed Technology Project (2015 - 2018)

Project Introduction

The goal of this project is to develop metal halide perovskites (MHPs) based solar cells for high temperature operation. MHPs have been recently discovered as high performance photovoltaic materials and the record power conversion efficiency of 20.1% has been reached. To date, silicon solar cells and multijunction solar cells have been dominantly used for space missions. Despite the previous success, employing these conventional solar cells for inner planet missions has been challenging due to loss of solar cell efficiency at high temperature. This originates mostly from the fact that all conventional solar cell materials exhibit negative temperature coefficient of bandgap which results in reduced open circuit voltage at high temperature. In contrast, very interestingly, MHPs exhibit positive and small temperature coefficient of bandgap which provides an intriguing opportunity for development of solar cells that maintain performance at high temperature. This project aims to combine experiments and first principles calculations to obtain fundamental understanding of the unusual positive temperature coefficient of bandgap of MHPs. The obtained insights will enable rapid material screening of various MHPs to identify compositions appropriate for specific mission temperature ranges. Prototype solar cells will be fabricated to test performance and stability at high temperature. If successful, this project will result in transformative advances in space solar power generation that enable higher specific power, lower cost and simpler operations compared to the state of the art approaches.

Anticipated Benefits

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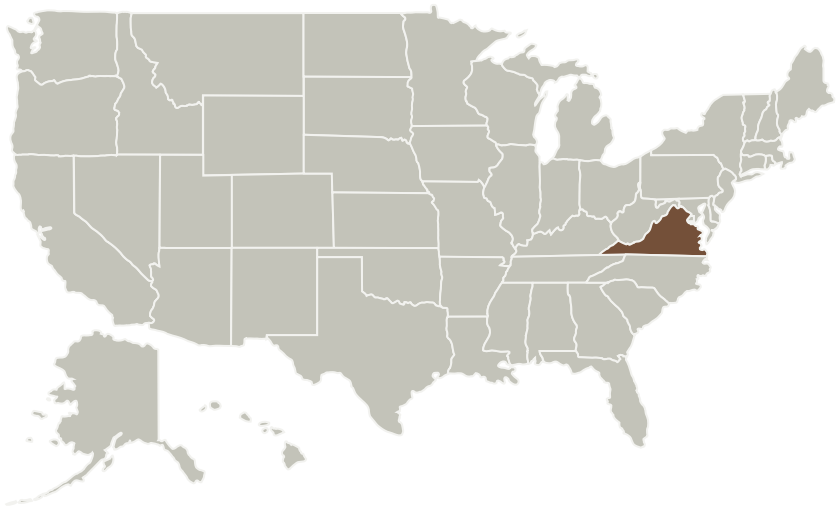
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Virginia-Main Campus	Lead Organization	Academia	Charlottesville, Virginia

Primary U.S. Work Locations
Virginia

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Virginia-Main Campus

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

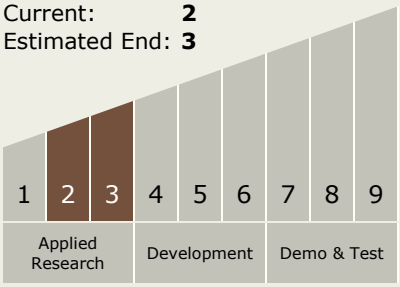
Hung D Nguyen

Principal Investigator:

Joshua S Choi

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



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Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.1 Power Generation and Energy Conversion
    - TX03.1.1 Photovoltaic

Target Destinations

Earth, Mars, Others Inside the Solar System